Amendments to the Specification

Replace the paragraph beginning on page 12, line 25 and ending on page 13, line 3 with the following amended paragraph:

Figure 2A illustrates a schematic diagram of a closed loop hermetically sealed cooling system 30 which includes an alternative flexible fluid delivery microchannel heat exchanger 100 in accordance with the present invention. In addition, Figure 2B illustrates a schematic diagram of a closed loop cooling system ~~30~~ 30' which includes an alternative flexible fluid delivery microchannel heat exchanger 100 with multiple ports ~~108, 109~~ 108', 109' in accordance with the present invention. It should be noted that the system alternatively incorporates other heat exchanger embodiments herein and is not limited to the alternative heat exchanger 100.

On page 13, replace the paragraph beginning on line 4 and ending on line 16 with the following amended paragraph:

As shown in Figure 2A, the fluid ports 108, 109 are coupled to fluid lines 38 which are coupled to a pump 32 and heat condensor ~~30~~ 36. The pump 32 pumps and circulates fluid within the closed loop 30. In one alternative, one fluid port 108 is used to supply fluid to the heat exchanger 100. In addition, one fluid port 109 is used to remove fluid from the heat exchanger 100. In one embodiment, a uniform, constant amount of fluid flow enters and exits the heat exchanger 100 via the respective fluid ports 108, 109. Alternatively, different amounts of fluid flow enter and exit through the inlet and outlet port(s) 108, 109 at a given time. Alternatively, as shown in Figure 2B, one pump provides fluid to several designated inlet ports ~~108~~ 108'. Alternatively, multiple pumps (not shown), provide fluid to their respective inlet and outlet ports 108, 109. In addition, the dynamic sensing and control module 34 is alternatively employed in the system to variate and dynamically control the amount and flow rate of fluid entering and exiting the preferred or alternative heat exchanger in response to varying hot spots or changes in the amount of heat in a hot spot location as well as the locations of the hot spots.

On page 14, replace the paragraph beginning on line 14 and ending on line 25 with the following amended paragraph:

Figure 3A illustrates a top view of the alternate manifold layer 106 of the present invention. In particular, as shown in Figure 3B, the manifold layer 106 includes four sides as well as a top surface 130 and a bottom surface 132. However, the top surface 130 is removed in Figure 3A to adequately illustrate and describe the workings of the manifold layer 106. As shown in Figure 3A, the manifold layer 106 has a series of channels or passages 116,~~118, 120,~~ 122 as well as ports 108, 109 formed therein. The fingers 118, 120 extend completely through the body of the manifold layer 106 in the Z-direction as shown in Figure 3B. Alternatively, the fingers 118 and 120 extend partially through the manifold layer 106 in the Z-direction and have apertures as shown in Figure 3A. In addition, passages 116 and 122 extend partially through the manifold layer 106. The remaining areas between the inlet and outlet passages 116,~~120,~~ 122, designated as 107, extend from the top surface 130 to the bottom surface 132 and form the body of the manifold layer 106.

On page 17, replace the paragraph beginning on line 14 and ending on line 21 with the following amended paragraph:

In the alternative embodiment, the inlet and outlet fingers 118, 120 are open channels which do not have apertures. The bottom surface~~103~~ 132 of the manifold layer 106 abuts against the top surface of the intermediate layer 104 in the three tier exchanger 100 or abuts against the interface layer 102 in the two tier exchanger. Thus, in the three-tier heat exchanger 100, fluid flows freely to and from the intermediate layer 104 and the manifold layer 106. The fluid is directed to and from the appropriate interface hot spot region by conduits 105 the intermediate layer 104. It is apparent to one skilled in the art that the conduits 105 are directly aligned with the fingers, as described below or positioned elsewhere in the three tier system.

On page 17, replace the paragraph beginning on line 22 and ending on line 28 with the following amended paragraph:

Although Figure 3B shows the alternative three tier heat exchanger 100 with the alternative manifold layer, the heat exchanger 100 is alternatively a two layer structure which

includes the manifold layer 106 and the interface layer 102, whereby fluid passes directly between the manifold layer 106 and interface layer 102 without passing through the ~~interface~~ intermediate layer 104. It is apparent to one skilled in the art that the configuration of the manifold, intermediate and interface layers are shown for exemplary purposes and is thereby not limited to the configuration shown.

On page 18, replace the paragraph beginning on line 8 and ending on line 23 with the following amended paragraph:

The conduits 105 are positioned in the ~~interface~~ intermediate layer 104 in a predetermined pattern based on a number of factors including, but not limited to, the locations of the interface hot spot regions, the amount of fluid flow needed in the interface hot spot region to adequately cool the heat source 99 and the temperature of the fluid. The conduits have a width dimension of 100 microns, although other width dimensions are contemplated up to several millimeters. In addition, the conduits 105 have other dimensions dependent on at least the above mentioned factors. It is apparent to one skilled in the art that each conduit 105 in the intermediate layer 104 has the same shape and/or dimension, although it is not necessary. For instance, like the fingers described above, the conduits alternatively have a varying length and/or width dimension. Additionally, the conduits 105 have a constant depth or height dimension through the intermediate layer 104. Alternatively, the conduits 105 have a varying depth dimension, such as a trapezoidal or a nozzle-shape, through the intermediate layer 104. Although the horizontal shape of the conduits 105 are shown to be rectangular in Figure ~~2C~~ 3B, the conduits 105 alternatively have any other shape including, but not limited to, circular (Figure 3A), curved, elliptical. Alternatively, one or more of the conduits 105 are shaped and contour with a portion of or all of the finger or fingers above.

On page 19, replace the paragraph beginning on line 9 and ending on line 16 with the following amended paragraph:

Figure 10A illustrates a perspective view of one embodiment of the interface layer 302 in accordance with the present invention. As shown in Figure 10A, the interface layer 302 includes a series of pillars 303 which extend upwards from the bottom surface 301 of the interface layer 302. In addition, Figure 10A illustrates a microporous structure ~~301~~ disposed on the bottom

surface 301 of the interface layer 302. It is apparent that the interface layer 302 can include only the microporous structure~~301~~ as well as a combination of the microporous structure with any other interface layer feature (e.g. microchannels, pillars, etc.). More details regarding the microporous structure are discussed below.

Replace the paragraph beginning on page 19, line 26 and ending on page 20, line 14 with the following amended paragraph:

The interface layer 302 alternatively includes a dense array of tall, narrow pillars 303 which extend perpendicular from the bottom surface 301 are in contact with the bottom surface of the manifold layer. Alternatively, the pillars 303 are not in contact with the bottom surface of the manifold layer. In addition, at least one of the pillars 303 alternatively extend at an angle with respect to the bottom surface 301 of the interface layer 302. The pillars 303 are also equidistantly spaced from one another along the interface layer 302 such that the heat transfer capabilities of the interface layer 302 are uniform across its bottom surface 301. Alternatively, the pillars 303B are spaced apart non-equidistantly as shown in Figure 10B, in which the pillars 303B in the middle of the interface layer 302 are spaced further apart than the pillars 303B' at the edges. The pillars 303B' are spaced apart depending on the dimensions of the heat source 99, and the flow resistance to the fluid as well as the size and locations of the hot spots and the heat flux density from the heat source 99. For instance, a lower density of pillars 303B' will offer less resistance to the flow, but will also offer less surface area for heat transfer from the interface layer 302 to the fluid. It should be noted that the configuration of the non-periodically spaced pillars 303B shown in the embodiment in Figure 10B are not limited thereto and are configured in any other arrangement depending on the conditions of the heat source as well as the desired operation of the cooling system 30 (Figure 2A).

On page 21, replace the paragraph beginning on line 15 and ending on line 21 with the following amended paragraph:

In the embodiment of the heat exchanger which utilizes a microporous structure~~301~~ disposed upon the interface layer 302, the microporous structure~~301~~ has an average pore size within the range of and including 10 to 200 microns for single phase as well as two phase fluid. In addition, the microporous structure~~301~~ has a porosity within the range and including 50 to 80

percent for single phase as well as two phase fluid. The height of the microporous structure ~~301~~ is within the range of and including 0.25 to 2.00 millimeters for single phase as well as two phase fluid.

On page 25, replace the paragraph beginning on line 4 and ending on line 14 with the following amended paragraph:

Figure 4 illustrates a perspective view of an alternative manifold layer 406 in accordance with the heat exchanger of the present invention. The manifold layer 406 in Figure 4 includes a plurality of interwoven or inter-digitated parallel fluid fingers 411, 412 which allow one phase and/or two-phase fluid to circulate to the interface layer 402 without allowing a substantial pressure drop from occurring within the heat exchanger 400 and the system 30 (Figure 2A). As shown in Figure ~~8~~ 4, the inlet fingers 411 are arranged alternately with the outlet fingers 412. However, it is contemplated by one skilled in the art that a certain number of inlet or outlet fingers can be arranged adjacent to one another and is thereby not limited to the alternating configuration shown in Figure 4. In addition, the fingers are alternatively designed such that a parallel finger branches off from or is linked to another parallel finger. Thus, it is possible to have many more inlet fingers than outlet fingers and vice versa.

Replace the paragraph beginning on page 25, line 22 and ending on page 26, line 6 with the following amended paragraph:

As shown in Figures 4-5, the alternative manifold layer 406 includes a passage 414 which is in communication with two inlet passages 411 and provides fluid thereto. As shown in Figures ~~8-9~~ 4-5 the manifold layer 406 includes three outlet passages 412 which are in communication with passage 418. The passages 414 in the manifold layer 406 have a flat bottom surface which channels the fluid to the fingers 411, 412. Alternatively, the passage 414 has a slight slope which aids in channeling the fluid to selected fluid passages 411. Alternatively, the inlet passage 414 includes one or more apertures in its bottom surface which allows a portion of the fluid to flow down to the interface layer 402. Similarly, the passage 418 in the manifold layer has a flat bottom surface which contains the fluid and channels the fluid to the port 408. Alternatively, the passage 418 has a slight slope which aids in channeling the fluid to selected outlet ports 408. In addition, the passages 414, 418 have a dimension width of approximately 2 millimeters, although

any other width dimensions are alternatively contemplated.

On page 26, replace the paragraph beginning on line 7 and ending on line 16 with the following amended paragraph:

The passages 414, 418 are in communication with ports 408, 409 whereby the ports are coupled to the fluid lines 38 in the system 30 (Figure 2A). The manifold layer 406 includes horizontally configured fluid ports 408, 409. Alternatively, the manifold layer 406 includes vertically and/or diagonally configured fluid ports 408, 409, as discussed below, although not shown in Figure 4-7. Alternatively, the manifold layer 406 does not include passage 414. Thus, fluid is directly supplied to the fingers 411 from the ports 408. Again, the manifold layer 411 alternatively does not include passage 418, whereby fluid in the fingers 412 directly flows out of the heat exchanger 400 through ports ~~408~~ 409. It is apparent that although two ports 408, 409 are shown in communication with the passages 414, 418, any other number of ports are alternatively utilized.

Replace the paragraph beginning on page 27, line 22 and ending on page 28, line 7 with the following amended paragraph:

The inlet and outlet passages 411, 412 are segmented and distinct from one another, as shown in Figures 4 and 5, whereby fluid among the passages do not mix together. In particular, as shown in ~~Figure 8~~ Figures 4 and 5, two outlet passages are located along the outside edges of the manifold layer 406, and one outlet passage 412 is located in the middle of the manifold layer 406. In addition, two inlet passages 411 are configured on adjacent sides of the middle outlet passage 412. This particular configuration causes fluid entering the interface layer 402 to travel a short distance in the interface layer 402 before it flows out of the interface layer 402 through the outlet passage 412. However, it is apparent to one skilled in the art that the inlet passages and outlet passages are positioned in any other appropriate configuration and is thereby not limited to the configuration shown and described in the present disclosure. The number of inlet and outlet fingers 411, 412 are more than three within the manifold layer 406 but less than 10 per centimeter across the manifold layer 406. It is also apparent to one skilled in the art that any other number of inlet passages and outlet passages are used and thereby is not limited to the number shown and described in the present disclosure.

On page 29, replace the paragraph beginning on line 6 and ending on line 19 with the following amended paragraph:

Figure 7A illustrates an exploded view of the alternate manifold layer 406 with the an alternative interface layer ~~102~~ 402 of the present invention. The interface layer ~~102~~ 402 includes continuous arrangements of microchannel walls 110, as shown in Figure 3B. In general operation, similar to the manifold layer 106 shown in Figure 3B, fluid enters the manifold layer 406 at fluid port 408 and travels through the passage 414 and towards the fluid fingers or passages 411. The fluid enters the opening of the inlet fingers 411 and flows the length of the fingers 411 in the X-direction, as shown by the arrows. In addition, the fluid flows downward in the Z direction to the interface layer 402 which is positioned below to the manifold layer 406. As shown in Figure 7A, the fluid in the interface layer 402 traverses along the bottom surface in the X and Y directions of the interface layer 402 and performs thermal exchange with the heat source 99. The heated fluid exits the interface layer 402 by flowing upward in the Z-direction via the outlet fingers 412, whereby the outlet fingers 412 channel the heated fluid to the passage 418 in the manifold layer 406 in the X-direction. The fluid then flows along the passage 418 and exits the heat exchanger by flowing out through the port 409.

On page 32, replace the paragraph beginning on line 8 and ending on line 16 with the following amended paragraph:

Figure 11 illustrates a broken-perspective view of a three tier heat exchanger 200 having the alternate manifold layer ~~200~~ 206 in accordance with the present invention. As shown in Figure 11, the heat exchanger 200 is divided into separate regions dependent on the amount of heat produced along the body of the heat source 99. The divided regions are separated by the vertical intermediate layer 204 and/or microchannel wall features 210 in the interface layer 202. However, it is apparent to one skilled in the art that the assembly shown in Figure 11 is not limited to the configuration shown and is for exemplary purposes. The heat exchanger 200 is coupled to one or more pumps, whereby by one pump is coupled to the inlets 208A and another pump is coupled to the inlet 208B.

On page 32, replace the paragraph beginning on line 17 and ending on line 26 with the following amended paragraph:

As shown in Figure 3B, the heat source 99 has a hot spot in location A and a warm spot, location B, whereby the hot spot in location A produces more heat than the warm spot in location B. It is apparent that the heat source 99 alternatively has more than one hot spot and warm spot at any location at any given time. In the example, since location A is a hot spot and more heat in location A transfers to the interface layer 202 above location A (designated in Figure 11 as interface hot spot region A), more fluid and/or a higher rate of liquid flow is provided to interface hot spot region A in the heat exchanger 200 to adequately cool location A. It is apparent that although interface hot spot region B is shown to be larger than interface hot spot region A, interface hot spot regions A and B, as well as any other interface hot spot regions in the heat exchanger 200, can be any size and/or configuration with respect to one another.

On page 33, replace the paragraph beginning on line 1 and ending on line 11 with the following amended paragraph:

Alternatively, as shown in Figure 11, the fluid enters the heat exchanger via fluid ports 208A is directed to interface hot spot region A by flowing along the intermediate layer 204 to the inflow conduits 205A. The fluid then flows down the inflow conduits 205A in the Z-direction into interface hot spot region A of the interface layer 202. The fluid flows in between the microchannels 210A whereby heat from location A transfers to the fluid by conduction through the interface layer 202. The heated fluid flows along the interface layer 202 in interface hot spot region A toward exit port 209A where the fluid exits the heat exchanger 200. It is apparent to one skilled in the art that any number of inlet ports 208 and exit ports 209 are utilized for a particular interface hot spot region or a set of interface hot spot regions. In addition, although the exit port 209A is shown near the interface layer 202~~A~~, the exit port 209A is alternatively positioned in any other location vertically, including but not limited to the manifold layer ~~209B~~ 206.

On page 33, replace the paragraph beginning on line 12 and ending on line 21 with the following amended paragraph:

Similarly, in the example shown in Figure 11, the heat source 99 has a warm spot in location B which produces less heat than location A of the heat source 99. Fluid entering through the port 208B is directed to interface hot spot region B by flowing along the intermediate layer 204~~B~~ to the inflow conduits 205B. The fluid then flows down the inflow conduits 205B in the Z-direction into interface hot spot region B of the interface layer 202. The fluid flows in between the microchannels 210 in the X and Y directions, whereby heat generated by the heat source in location B is transferred into the fluid. The heated fluid flows along the entire interface layer 202~~B~~ in interface hot spot region B upward to exit ports 209B in the Z-direction via the outflow conduits 205B in the intermediate layer 204 whereby the fluid exits the heat exchanger 200.

Replace the paragraph beginning on page 38, line 26 and ending on page 39, line 12 with the following amended paragraph:

Figure 12G illustrates a perspective underside view of an alternative embodiment of the level 312' in accordance with the present invention. The level 312' is coupled to the level 308' in Figure 12E. As shown in Figure ~~12F~~ 12G, the level 312' includes a recessed corridor area 328' within the body which is exposed along the bottom surface 312B'. The recessed corridor 328' is in communication with the port 316', whereby fluid travels directly from the recessed corridor 328' to the port 316'. The recessed corridor 328' is positioned above the top surface 308A' of the level 308' to allow fluid to freely travel upward from the apertures 324' to the corridor 328'. The perimeter of the recessed corridor 320' and bottom surface 312B' is sealed against the top surface 308A' of the level 312' such that all of the fluid from the apertures 324' flows to the port 316' via the corridor 328'. Each of the apertures 330' in the bottom surface 312B' is aligned with and in communication with a corresponding aperture 321' in the level 308' (Figure 12E), whereby the apertures 330' are positioned flush with the top surface 308A' of the level 308' (Figure 12E). Alternatively, the apertures 330 have a diameter slightly larger than the diameter of the corresponding aperture 324', whereby the apertures 324' extend through the apertures 330' into the corridor 328'.